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FINAL$_{V.2}$ PROPOSED REMEDIAL ACTION PLAN

Sites 6 and 7
Naval Weapons Station Yorktown
Yorktown, Virginia

Issued by: LANTNAVFACENGCOM, Norfolk, VA
Prepared by: Baker Environmental, Inc.

MAY 1998

INTRODUCTION

This Proposed Remedial Action Plan (PRAP) is issued to describe the Department of the Navy's (DoN'S) preferred remedial action for Site 6 (Explosives-Contaminated Wastewater Impoundment) and Site 7 (Plant 3 Explosives-Contaminated Wastewater Discharge Area) at Naval Weapons Station (WPNSTA) Yorktown, Yorktown, Virginia.

This PRAP was prepared to satisfy the DoN's public participation responsibility under Section 117(1) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), and the Federal Facilities Agreement (FFA) between the DoN, the United States Environmental Protection Agency (USEPA) Region III, and the Commonwealth of Virginia Department of Environmental Quality (VDEQ).

The primary purpose of this plan is to describe investigative work and the remedial alternatives (cleanup actions) evaluated for Sites 6 and 7 and to identify the DoN's preferred cleanup alternative. Community involvement is critical to the selection of a final cleanup remedy as it may cause the DoN to modify the preferred alternative or to select another alternative. Public comment is invited and encouraged on the preferred alternative and the other alternatives evaluated for Sites 6 and 7. Information on community participation in this decision-making process is presented at the end of this plan.

This plan provides a description and history of both sites, an explanation of the nature and extent of contamination found at the sites, a summary of site risks, a summary of actions taken to date, a summary of alternatives, an evaluation of the alternatives, a description of the preferred alternative, and information regarding community participation.

DATES TO REMEMBER:

May 26, 1998 to July 11, 1998 - Public comment period on remedial action alternatives for Sites 6 and 7.

May 26, 1998 - Public meeting at the York County Recreational Services Meeting Room, 301 Goodwin Neck Road, Yorktown, Virginia at 6:30 p.m.

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Both the PRAP and the Record of Decision will be available at the information repositories listed on pages 22 and 23 of this document

SITE BACKGROUND

Site Description and History

Site 6-Explosives-Contaminated Wastewater Impoundment

The Site 6 Study Area covers approximately 94 acres and includes the area surrounding Buildings 109, 110, and 501; the explosives-contaminated wastewater impoundment area with associated drainage way; an excavated area; and a tributary to Felgates Creek (See Figures 1 and 2). A drainage way originating from the Building 109 area discharges to the impoundment. North of the impoundment, a previously excavated area has been identified via aerial photography. This area is currently wooded, but concrete rubble is evident in the excavated areas. The Site 6 Study Area generally slopes to the west toward the impoundment area.

The Site 6 unlined wastewater impoundment area was formerly used during the years of 1942 through 1975 as a settling basin for nitramine-contaminated washdown water. The contaminated wastewater was generated from the explosives reclamation facility at Building 109. The explosives reclamation facility released solvents such as trichloroethene (TCE) and 1,1,1-trichloroethane (1,1,1-TCA) and nitramine compounds such as 2,4,6-trinitrotoluene (TNT) and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) to the impoundment area by means of a concrete-lined drainage channel that emanates from Building 109.

The public is encouraged to review and comment on all of the alternatives presented in this PRAP. Based on new information or comments received from the public, the DoN may modify the preferred alternative or select another alternative presented in this plan.

The history of the excavated area identified north of the impoundment is not documented. The area may have been a former soil borrow pit, from which soil was obtained, or material may have been disposed and buried at this location.

Site 7 - Plant 3 Explosives-Contaminated Wastewater Discharge Area

Site 7 is a 300-foot long (approximate length) drainage area located adjacent to wetlands and along a small tributary to Felgates Creek (See Figures 1 and 2), approximately one mile upstream from the confluence of Felgates Creek and the York River. The actual study area for Site 7 covers approximately 62 acres and includes the area surrounding Buildings 375, 502, 503, and 504 (collectively known as Loading Plant 3) as well as a drainage area and a tributary to Felgates Creek.

The Site 7 discharge area received nitramine-contaminated wastewater from Loading Plant 3 between 1945 to 1975.

Previous Investigations

Several investigations have been conducted for Sites 6 and 7:

- Initial Site Assessment (IAS), 1984
- Confirmation Study - Rounds One and Two, 1986 & 1988
- Focused Biological Sampling and Preliminary Risk Evaluation, 1993
- Round One Remedial Investigation (RI), 1992 - 1993
- Habitat Evaluation, 1995
- Soil Characterization Study, 1995
- A Field-Scale Pilot Study at Site 7, 1996
- Round Two RI, 1996
- Supplemental Investigation to the Round Two RI, 1996
- RCRA Sampling Investigation at Site 6 - AOC C and SWMU 179, 1996
- Ecological Toxicity Study at Site 6, 1997
- Site 6 Flume Area Composite Sample, 1998

Brief summaries of these previous investigations are presented below. Specific details of these investigations can be found in the individual documents which are available to the public for review at the Information Repositories listed on page 20.

Initial Assessment Study

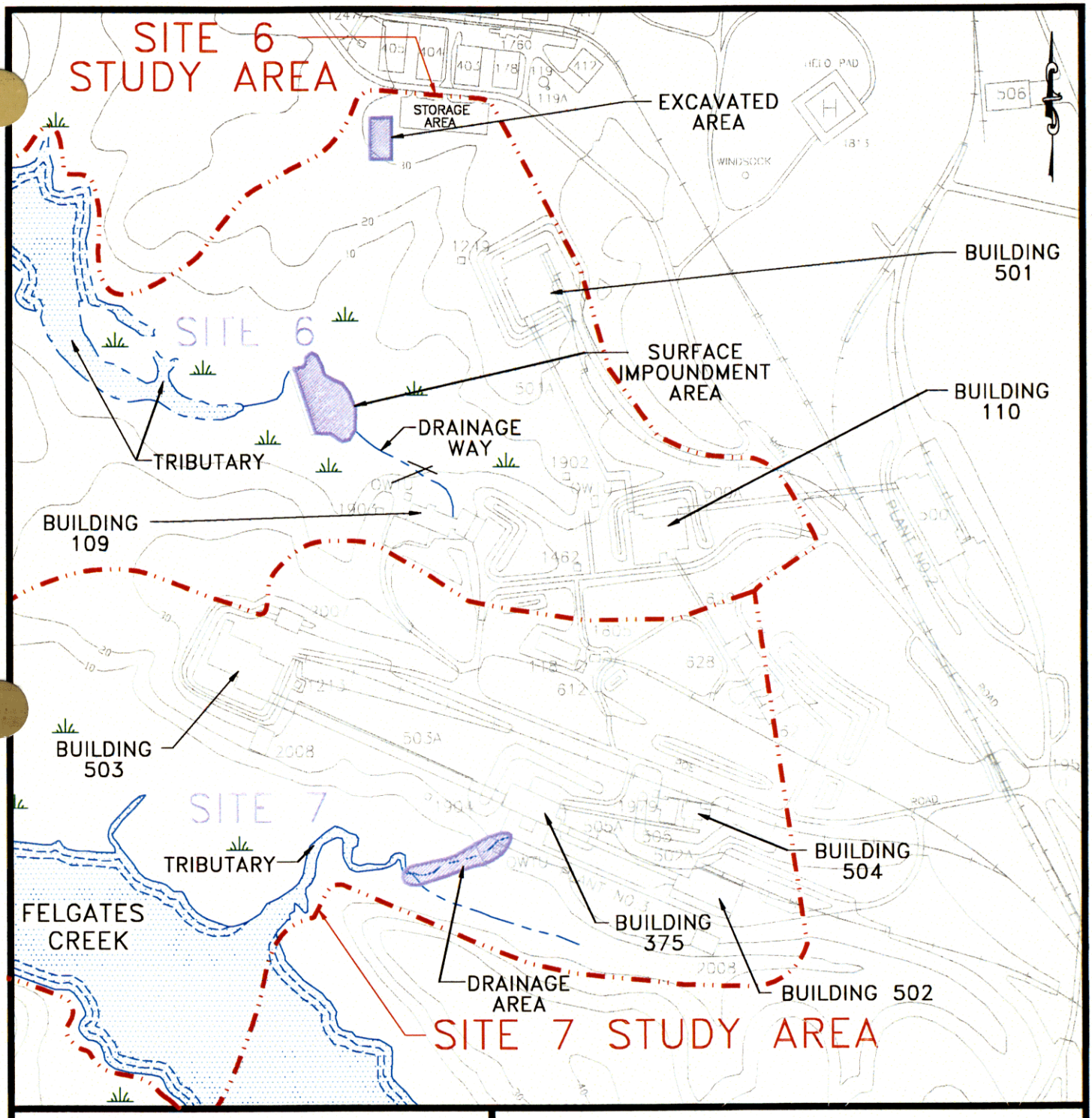
The IAS was conducted for WPNSTA Yorktown to identify and assess sites posing a potential threat to human health and/or the environment due to contamination from past operations. Nineteen potentially contaminated sites were identified at the Station based on information from historical records, aerial photographs, field inspections, and personnel interviews. The IAS concluded that Sites 6 and 7 were of sufficient threat to human health or the environment to warrant Confirmation Studies.

Confirmation Study

Two rounds of data were obtained from WPNSTA Yorktown during the Confirmation Study. The first round was obtained in 1986, and the second round was obtained in 1988. The results of the analyses were compared with appropriate regulatory standards. The report findings from the Confirmation Study were later summarized in an RI Interim Report. The RI Interim Report recommended that further RI activities be conducted at Site 6 and Site 7.

Focused Biological Sampling and Risk Evaluation Report

The Focused Biological Sampling and Preliminary Risk Evaluation Report summarized the results of a limited biological tissue, surface water, and sediment sampling effort conducted October 1992. The primary objective of the sampling program



400 0 200 400

1 inch = 400 ft.

- DRAINAGE
- MARSH
- RAILROAD
- FENCE
- TREE LINE
- APPROXIMATE LIMIT OF STUDY AREA
- EDGE OF PAVEMENT
- STRUCTURE/BUILDING WITH NUMBER
- REMEDIAL INVESTIGATION AREA
- SURFACE WATER BODY
- GROUND SURFACE ELEVATION CONTOUR (FEET, ABOVE MEAN SEA LEVEL)

319644FS

FIGURE 1
SITES 6 AND 7
STUDY AREAS

NAVAL WEAPONS STATION YORKTOWN YORKTOWN, VIRGINIA

Baker
Baker Environmental, Inc.

800 0 400 800
1 inch = 800 ft.

FIGURE 2
AERIAL PHOTOGRAPH
SITES 6 AND 7
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

was to evaluate the potential human health risk associated with consumption of fish and shellfish taken from select waters within WPNSTA Yorktown, including Felgates Creek, which is adjacent to Sites 6 and 7.

The data from this study was intended to be used by the DoN to decide if interim measures should be required in the waters such as restricting fishing. The analytical results of the biota sampling indicated that contaminants from WPNSTA Yorktown have not bioaccumulated in significant quantities in the fish and shellfish of Lee Pond, Roosevelt Pond, Indian Field Creek or Felgates Creek to pose a significant risk to individuals fishing from these water bodies.

Round One Remedial Investigation

The results of the Round One RI, conducted in 1992, indicated that further investigation was needed at all of the IRP sites investigated to better define the nature and extent of contamination associated with each site.

With respect to Site 6, organic and inorganic compounds were detected in all media sampled during the Round One RI. However, as only one groundwater monitoring well was installed at Site 6, the Round One RI provided limited information on the subsurface conditions, including both subsurface soil and groundwater. Nitramine compounds and volatile organic compounds (VOCs) were detected in surface water and sediment; however, insufficient data existed to determine the extent of this contamination. Also, because previous surface water and sediment data exceeded applicable criteria and standards, benthic macroinvertebrate and fish population data were deemed necessary to evaluate the potential risk to the environment. As such, the nature and extent of the contamination at Site 6 was not completely defined by the results of the Round One RI. Additional sampling was recommended for all media to better define the nature and extent of contamination at Site 6.

With respect to Site 7, organic and inorganic constituents were detected in all media sampled. However, only one groundwater sample was collected to evaluate the groundwater quality. Organic compounds were detected in surface water, but the extent of this contamination could not be clearly defined. Also, because previous surface water and sediment data exceeded applicable criteria and standards, benthic macroinvertebrate and fish population data were deemed necessary to evaluate the potential risk to the environment. As such, the nature and extent of the contamination at Site 7 was not completely defined by the results of the Round One RI. Additional sampling was recommended for all media to better define the nature and extent of contamination at Site 7.

Habitat Evaluation Report

A habitat evaluation was conducted in September 1994 at 15 sites at WPNSTA Yorktown, including Sites 6 and 7. The objectives of the study were to: identify potential aquatic and terrestrial receptors for the ecological risk assessment; identify habitats within the study areas; identify existing wetland areas and sensitive environments; and identify any endangered species in the study areas.

With respect to Site 6, birds observed at the site included species that breed in the area and migrant species that pass through the area during the Spring and Fall migration. A small snake (type not identified) and signs of deer, raccoons, and groundhogs were identified at the site. With respect to Site 7, common bird species and one neotropical migrant were heard and/or observed during the evaluation. In addition, signs of deer and groundhogs were noted. No endangered species were identified at either site. However, an osprey nesting site was observed near Sites 6 and 7 in the Spring of 1998. The Migratory Bird Treaty Act protects these birds and their nesting sites.

Existing non-tidal (freshwater) and tidal (salt water) wetland areas were identified within the Site 6 Study Area. Tidal wetland areas were identified within and Site 7 Study Area.

Round Two Remedial Investigation

A Round Two RI was conducted during 1994 and 1996 at Sites 6 and 7 to assess the nature and extent of contamination at the site and to address potential data gaps observed following the Round One RI.

With respect to Site 6, the media sampled during this investigation included surface and subsurface soils, groundwater, surface water, and sediment. No organics, with the exception of laboratory contaminants, were detected in surface soil samples. VOCs in subsurface soil identified as chlorinated solvents were detected approximately halfway between Building 109 and the drainage/discharge area to the wastewater impoundment area. Concentrations and the number of compounds increased with depth. Chlorinated solvents (VOCs) and explosive constituents were detected in the groundwater samples. Surface water samples indicated the presence of VOCs within the impoundment area. Sediment samples only indicated the presence of semivolatile organic compounds (SVOCs) within the drainage ways to the impoundment area and VOCs, SVOCs and nitramine compounds within the impoundment area. The tributary to Felgates Creek did not appear to have been impacted by VOCs, SVOCs, or nitramine compounds.

At Site 7, the media sampled during the Round Two RI included surface soils, subsurface soils, groundwater, surface water, and sediment. Results from this investigation showed VOC and SVOC laboratory contaminants detected in the surface and subsurface soil samples. VOCs and nitramine compounds were detected in groundwater with the highest concentrations observed in the general area around the explosives-contaminated wastewater discharge area. VOCs (not including laboratory contaminants) were detected in the surface and subsurface sediment samples at Site 7. There were no SVOCs (with the exception of laboratory contaminants) or nitramine compounds

detected in the surface water or sediment samples collected during the Round Two RI at Site 7.

Soil Characterization Study

A Soil Characterization Study was conducted in December 1996, which focused on specific locations at Site 6 and Site 7 that were suspected of having high concentrations of nitramines. The Site 6 location was at the discharge point of two concrete drainage channels, which formerly conveyed waste water from Buildings 109 and 110. The Site 7 location was at the drainage area from Building 375. The purpose of this study was to characterize the nitramine-contaminated soil and to collect representative soil samples for a treatability study. Nitramines were detected at both Site 6 and Site 7.

Field Scale Pilot Study At Site 7

A field-scale pilot study to treat explosives-contaminated soil at Site 7 was conducted between September and December of 1996. The purpose of the study was to determine the technical implementability, effectiveness, and future costs of an anaerobic remediation technology used to treat explosives-contaminated soil. Approximately 770 cubic yards of soil were excavated from the drainage area leading to the tributary at Site 7. Soil with TNT concentrations exceeding 30 parts per million (ppm) were excavated and sent to the newly-constructed biocell at another site at WPNSTA Yorktown. The TNT concentrations in the soil entering the biocell averaged over 1,000 ppm. After treatment, the TNT concentrations ranged from less than 1 ppm to 4 ppm. At the completion of this pilot study, Site 7 was considered to have been remediated. Details of this study are found in the Final Study Pilot Report for the Explosives-Contaminated Soil at the Naval Weapons Station Yorktown, Yorktown, Virginia, (Baker, 1997).

Supplemental Investigation at the Impoundment Area

A Supplemental Investigation to the Round Two RI was conducted in February 1996 at the Site 6 impoundment area to collect additional data to delineate the potential extent of contamination within the impoundment. The Supplemental Investigation included the collection of shallow soil samples and sediment samples. Shallow soil samples were collected along the northern and eastern banks of the impoundment and sediment samples were collected throughout the impoundment area. Analytical results indicated that the sediments have been impacted by VOCs, SVOCs, and nitramine compounds, particularly in the vicinity of the former wastewater discharge area of the impoundment.

RCRA Sampling Investigation at Site 6 - AOC C and SWMU 179

The FFA identified two RCRA concerns associated with Site 6. Building 109 (contaminated structure) at Site 6 has been labeled Resource Conservation Recovery Act Area of Concern "C" (RCRA AOC C). In addition, the trenches and piping associated with and adjacent to Building 109 has been labeled RCRA Solid Waste Management Unit (SWMU) 179. Following the conductance of the Round Two RI for Site 6, USEPA raised the issue of focussing on these two RCRA units as part of th Round Two RI.

The RI identified that the soil and groundwater north of Building 109 near the drainage way contained high levels of VOCs. The original source of this contamination is due to the past operations in Buildings 109; but the presence of an existing secondary source of the VOCs associated with the TCE distillation unit was not evident. Additional subsurface soil samples were collected in the area immediately north of Building 109 to determine whether the TCE distillation unit, SWMU 179 and AOC C were contributing to Site 6 contamination. In July 1996, 11 soil samples were collected in the drainage ways from Buildings 109 and 110, in areas of potential secondary source contamination. Based on the sample results, it was concluded that these RCRA concerns are not sources of contamination to Site 6 proper.

Site 6 Sediment Toxicity Study

The Navy, USEPA and the Commonwealth of Virginia were still concerned about quantifying the potential risks associated with contaminants located in the flume area, particularly the effects on ecological receptors.

In October 1996, fourteen additional soil samples were collected at Site 6. The samples were collected at depths ranging fr 0 to 1 foot bgs. One sample was obtained at 3 feet bgs t determine extent at depth. All of the samples were field tested for TNT and submitted to a laboratory for VOC analysis. In addition, two of the samples were analyzed for Toxic Characteristic Leaching Procedure (TCLP) analysis. TNT test kit results indicated that all of the soil samples collected had TNT concentrations less than 30 parts per million. With respect to VOCs, three of the samples had detectable concentrations of 1,2-dichloroethene (1,2-DCE), TCE, acetone, or 1,1,1-trichloroethane (1,1,1-TCA).
Based on the data and information gained from the October 1996 sampling event, the RCRA concerns at SWMU 179 and AOC C appeared to be addressed. No further actions or investigations were recommended for these specific RCRA units.

Ecological Toxicity Study for Site 6

An ecological toxicity study was conducted on the sediment in the drainage area at Site 6 in 1997. The purpose of the study was to further define the extent of explosive contamination in the flume area (drainage area), and to establish toxicity-based, site-specific cleanup goals for the explosive contaminants.

In August, 1997, Baker collected a series of sediment samples from the drainage area (within the flume area). Because of the lack of explosives ecological toxicity values in the literature, t sediment samples were submitted to an off-site analyti laboratory and to an ecological toxicity laboratory for analysis. Both acute (10-day) and chronic (28-day) ecological toxicity tests were conducted on the sediments. The tests indicate that

concentrations of TNT above a range of 68,000 to 118,000 µg/kg can have a potential effect on invertebrates living in the sediment of the Site 6 drainage flume area.

Site 6 Flume Area Composite Sample

On February 11, 1998, a composite soil sample was collected from the drainage flume area (near the concrete flumes). The soil sample was split with W.R. Grace Company to evaluate the efficiency of their proprietary bioremediation technology. VOCs, SVOCs, explosives and inorganics were detected in the composite sample.

Nature and Extent of Contamination

The nature and extent of contamination identified at Sites 6 and 7 is discussed below. The discussion is based on the analytical data generated from the Round One RI, the Round Two RI, including the Supplemental Investigation conducted at the Site 6 impoundment area, and the Soil Characterization Study. This section also includes the nature and extent of contamination prior to the Field Scale Pilot Study, during which the contaminated soil at Site 7 was removed as part of the Pilot Study.

Site 6

Surface soil, subsurface soil, groundwater, surface water and sediment were sampled during both the Round One and Round Two RIs. Based on the analytical results from the Round One RI the surface soil at Site 6 does not appear to have significant wide-spread contamination. Trace concentrations of toluene, and low concentrations of SVOCs, including polynuclear aromatic hydrocarbons (PAHs) and bis(2-ethylhexyl)phthalate (BEHP), (less than 530 µg/kg) were detected. Nitramine compounds were detected at one location that formerly received run-off from the loading complex. Octohydro-1,3,5,7-trinitro-1,3,5,7-tetranitro (HMX) and RDX were detected at concentrations of 5,600 µg/kg and 2,900 µg/kg, respectively, at this location. During the subsequent Soil Characterization Study, higher levels of nitramines were detected at the discharge location of two concrete drainage channels, which formerly conveyed waste water from Building 109. HMX, RDX, TNT, and amino-dinitrotoluenes (amino-DNTs) were detected at concentrations of 21,000 µg/kg, 194,000 µg/kg, 2,690,000 µg/kg, and 7,310 µg/kg, respectively, at this location.

Based on the analytical results from Round One and Round Two RIs, elevated levels of VOCs and nitramines were identified within the subsurface soil at Site 6 between Building 109 and the impoundment area and downgradient from the discharge location of the concrete drainage channel from Building 109. The elevated VOCs included vinyl chloride, cis-1,2-dichloroethene (cis-1,2-DCE), and TCE. Elevated detections of nitramine concentrations include nitrobenzene, 2,6-DNT; 2,4-DNT; HMX; RDX; 1,3,5-trinitrobenzene (1,3,5-TNB); and TNT. The highest concentrations detected were TNT at 640,000 µg/kg, RDX at 160,000 µg/kg, and HMX at 61,000 µg/kg. Round Two analytical results indicated that 2,500 µg/kg of 4-amino-DNT and 2-amino-DNT were detected. Subsurface soil VOC and nitramine compound contamination is related to former on-site operations.

Results of the Round One and Round Two RIs indicate that the groundwater (Yorktown-Eastover aquifer) at Site 6 has been affected by VOC and nitramine compound contamination. The contamination was found primarily at the same locations as the subsurface soil contamination. The elevated VOCs detected include TCE and cis-1,2-DCE. Nitramine compounds were also detected with the highest detected concentration of 80 µg/L for RDX. Additionally, low concentrations of 4-amino-2,6-DNT and HMX were reported in one monitoring well.

Results of the Round One and Round Two RIs indicate that surface water in the impoundment area and in the drainage areas leading to the impoundment area at Site 6 has been impacted by VOCs and nitramines. VOC contamination was primarily related to 1,1,1-TCA at a concentration of 98 µg/L found in the drainage area to the impoundment. Low concentrations of VOCs and nitramines were detected in the impoundment area. No VOCs were detected in the tributary to Felgates Creek or in Felgates Creek. Nitramine compounds detected in the surface water included HMX, RDX, and TNT with maximum concentrations of 12 µg/L, 33 µg/L, and 36 µg/L, respectively, in the impoundment area. There were no nitramine compounds detected in the drainage areas to the impoundment area, the tributary to Felgates Creek, or Felgates Creek. Considering the distribution and concentration of VOCs and nitramine compounds in surface water, it is likely that the VOC and nitramine compound contamination found in the surface water at Site 6 is related to contamination from surface soil/sediment in the drainage area and the impoundment area, which may be a secondary source area.

Analytical data for sediment at Site 6 was collected during the Round One RI, the Round Two RI, the Supplemental Investigation and the Ecological Toxicity Study. These data indicate that sediment in the drainage area from Buildings 109 and 110 and in the impoundment area at Site 6 has been impacted by VOC, SVOC, and nitramine compound contamination. SVOCs detected in the sediment in the drainage area surrounding the impoundment area include PAHs, which may be attributed to anthropogenic contamination and general storm water runoff from the roadways which cross the site. Nitramine compounds appear to be the most significant compounds detected in the sediment samples collected in the drainage area leading from Buildings 109 and 110 to the impoundment area. The highest concentrations of nitramines at Site 6 were detected in this drainage area. TNT, HMX, RDX, and 2-amino-DNT concentrations were as high as 93,000,000 µg/kg; 730,000 µg/kg; 3,900,000 µg/kg; and 160,000 µg/kg, respectively, during the Round One and Two RIs, and the Supplemental Investigation. It appears that the majority of the nitramine contamination is located in the deeper sediments (6 inches to 42 inches deep) in this drainage area. High levels of VOCs were also detected in sediment at a depth

of one foot during the Round One RI. VOCs, SVOCs, and nitramine compounds were detected in the sediment samples collected in the impoundment area during the Supplemental Investigation. VOCs detected in the sediment included laboratory contaminants and low concentrations of other VOCs such as vinyl chloride, 1,1-dichloroethane (1,1-DCA), 1,2-DCE, and TCE. SVOCs detected in the sediment included numerous PAHs and several laboratory contaminants. Nitramine compounds detected in the sediment included TNT, 1,3,5-TNB, 1,3-dinitrobenzene (1,3-DNB), and 4-amino-DNT. Significant levels of nitramines were found at a depth of 24 to 48 inches.

The Ecological Toxicity Study sediment samples from the Site 6 Drainage Flume Area showed maximum concentrations of HMX, RDX, TNT, amino-DNTs, and DNTs of 45,000 µg/kg, 120,000 µg/kg, 1,000,000 µg/kg, 1,240,000 µg/kg, and 12,200 µg/kg, respectively.

Considering the distribution of VOC and nitramine contamination in Site 6 sediment, it appears that this contamination is related to historical discharges from the drainage channel that emanates from Building 109, which formerly conveyed waste water from reclamation activities and discharged it into the Site 6 impoundment area. The building is no longer in operation.

Site 7

Results of surface soil sampling from the Round One RI indicate that only trace concentrations of SVOC laboratory contaminants were detected in surface soil at Site 7. These compounds are considered to be unrelated to Site 7. During the subsequent Soil Characterization Study at Site 7, elevated levels of nitramines were detected at the drainage/discharge area, which formerly conveyed waste water from Building 375. HMX, RDX, TNT, and amino-DNTs were detected at maximum concentrations of 3,200,000 µg/kg, 14,000,000 µg/kg; 40,000,000 µg/kg; and 84,700 µg/kg, respectively, at this location.

Based on the analytical results of subsurface soil sampling from the Round Two RI, only trace concentrations of VOC laboratory contaminants were detected at Site 7. These compounds are considered to be unrelated to Site 7.

Results of the Round One and Round Two RIs indicate that the groundwater at Site 7 (Yorktown-Eastover aquifer) has been affected by VOC and nitramine compound contamination. Relatively low levels of nitramines and VOCs were detected in several monitoring well samples. Detected VOCs included 1,1-DCA, 1,1-DCE, and 1,1,1-TCA. Detected nitramines included HMX, RDX, and 4-amino-DNT. Considering the distribution and concentration of VOCs and nitramine compounds and groundwater flow patterns, it appears that the VOC and nitramine compound contamination found at Site 7 is related to an on-site source resulting from former operations.

Analytical data collected from the surface water samples during the Round One RI indicate that surface water in the drainage areas emanating from Building 375 has been impacted by VOCs. VOC contamination was primarily related to 1,1-DCA and 1,1,1-TCA. Trace concentrations of nitramines were detected in the tributary to Felgates Creek and in Felgates Creek. During the Round Two RI, analytical data collected from surface water samples indicated no impacts to surface water at Site 7. A possible reason for the inconsistent surface water data results between Round One and Round Two is that the surface water during both sampling events may have been affected by different tidal influences.

Analytical data for sediment at Site 7 was collected during the Round One RI and the Round Two RI. These data indicate only trace concentrations of VOC laboratory contaminants and relatively low levels of SVOCs, which may be attributed to anthropogenic contamination and general storm water runoff from the roadways which cross the site. Sediments in Felgates Creek and the tributary to Felgates Creek have not been impacted by VOC, SVOC, or nitramine contamination.

Felgates Creek

There were trace detections of VOCs, SVOCs, or nitramine compounds in the surface water in Felgates Creek during Round One RI sampling.

It does not appear that Sites 6 or 7 are a source of contamination for sediment in Felgates Creek. The sediment data indicate only trace concentrations of VOC laboratory contaminants and relatively low levels of SVOCs, which may be attributed to anthropogenic contamination and general storm water runoff from the roadways which cross the site. There were no detections of nitramine compounds in the sediment in Felgates Creek.

SUMMARY OF SITE RISKS

As part of the RI, human health and ecological risk assessments (RAs) were conducted to evaluate the current and future potential risks to human health and the environment from contamination at Sites 6 and 7. In general, an RA is a way to determine the risks associated with a chemical and the potential effects that the chemical can have on an individual or on a population. RAs also consider effects on animal populations and on the environment.

A summary of the human health and ecological RAs conducted for Sites 6 and 7 is presented below. The RAs for Site 7 discusses risks prior to the Field Scale Pilot Study at Site 7 during which contaminated soils were removed as part of the Pilot Study.

Actual or threatened releases of hazardous substances from this site, if not addressed by the preferred alternative or one of the other active measures considered, may present a current or potential threat to public health, welfare, or the environment.

Human Health Risk Assessment

The human health RA was comprised of four basic steps.

Hazard Identification identifies the contaminants of potential concern (COPCs) at the sites based on several factors such as toxicity, frequency of occurrence, and concentration. *Exposure Assessment* estimates the magnitude of actual and/or potential human exposures, the frequency and duration of these exposures, and the pathways by which humans are potentially exposed. *Toxicity Assessment* determines the types of adverse health effects associated with chemical exposures and the relationship between the magnitude of exposure (dose) and the severity of adverse effects (response). *Risk Characterization* summarizes and combines the results of the exposure and toxicity assessments to determine the likelihood, or risk, that adverse cancer and non-cancer effects could occur in people who contact chemicals at a site.

COPCs that were identified for all media are presented on Table 1 for Site 6, and Table 2 for Site 7.

With respect to the potential risk due to exposure to a COPC, the USEPA has set an acceptable target risk range for human health. Quantitative risk calculations for possibly carcinogenic compounds are used to estimate the incremental cancer risk (ICR) for a person in a particular population (specified in the model being used). This unit of risk refers to a potential cancer risk that is above background cancer risk in individuals that have not been exposed to the COPCs. The USEPA target risk range is $1x10^{-6}$ to $1x10^{-4}$. For example, an ICR of $1x10^{-6}$ indicates that an exposed person has an increased probability of one in one million of developing cancer due to the exposure to the COPC, over the course of their lifetime.

For noncarcinogenic risks, a different type of calculation is used. The effects of exposure to a COPC in each media by different pathways (ingestion, inhalation, or dermal contact) are calculated. These values are called hazard quotients (HQs). An HQ is the ratio of the daily intake or absorbed dose to the reference dose. The reference dose is the dose that is the minimum that can cause noncarcinogenic effects for a particular chemical. The HQs for each media and exposure pathway are added up. The sum of all the HQs is called the hazard index (HI). If an HQ or the HI is more than 1.0, there may be a risk of noncarcinogenic health effects.

Current and future scenarios of possible human contact with the sampled media were analyzed. Receptors and exposure pathways were evaluated in the RA are listed in Table 3.

Both current and future scenarios showed potential noncarcinogenic risk due to ingestion and dermal contact with explosives in sediment, and subsurface soil at Site 6. At Site 7, one future scenario showed potential noncarcinogenic risk due to ingestion of antimony, arsenic, iron, and manganese in surface soil. The surface soil risk results were driven by one sample that contained elevated levels of these constituents. This soil was removed as part of the Field Scale Pilot Study.

Ecological Risk Assessment

An ecological RA was conducted for Sites 6 and 7. The ecological RA included the identification of potential ecological contaminants of concern (ECOCs). The ECOCs were selected based on a screening of the maximum detected concentrations in the surface soil, surface water, and sediment against screening levels. If the concentrations were higher than the screening levels, they were identified as a potential ECOC. These ECOCs were then compared with accepted values of concentrations that produce no observable adverse effects, or the lowest observable adverse effects on the ecological receptors (plants and animals). Potential risks to the plants and animals were evaluated for different exposure pathways. Risks due to ingestion of water, soil, sediment, vegetation and/or smaller animals were modeled for benthic macroinvertebrates, the Largemouth Bass, Great Blue Heron, Bullfrog, surface soil flora and fauna, the American Woodcock, Red-Tailed Hawk, American Robin, Marsh Wren, Red Fox, Short-Tailed Shrew, Meadow Vole, and the Deer Mouse.

In conclusion, surface soil at Site 6 (Impoundment/ Drainage Area, and Excavated Area) pose a potential risk to the aquatic ecosystem. Sediment at Site 6 (Impoundment/Drainage Area, Drainage Flume Area, and Tributary), may pose a potential risk to the aquatic ecosystem.

SCOPE AND ROLE OF ACTION

A partnering meeting (March 26-27, 1998) was held with representatives from the Navy, USEPA, and the Commonwealth of Virginia. During this meeting, Site 7 was defined as Operable Unit (OU) 12. For Sites 6 and 7, Operable Units have been defined based on location and similar contaminants which can be treated in a similar way. There will be no further action at OU 12 for groundwater, surface water, sediment or soil. The Site 6 Drainage Flume Area (Soil Area of Concern, SAOC #1) was defined as OU 13. Site 6 Excavated Area (SAOC #3) was defined as OU 14. The groundwater for all of Site 6, and the surface water and sediment in the Site 6 Impoundment Area (SAOC #2) was defined as OU 15. For Site 6 (OUs 13, 14 and 15), the overall strategy for remediating the site will address surface soils contaminated with inorganics and explosives, subsurface soils contaminated with explosives, and shallow sediment contaminated with volatiles, semivolatiles, pesticides, explosives and inorganics.

Soil and sediment from Site 7 was excavated and sent to a biocell at Site 22 at WPNSTA Yorktown for biological remediation as part of a pilot study. The average concentration of TNT was over 1,000 ppm in the excavated soil, and was remediated to levels of 1 ppm to 4 ppm. Therefore, Site 7 is considered to be remediated and no further action will be taken at Site 7.

TABLE 1

SITE 6

SUMMARY OF HUMAN HEALTH COPCs FOR SOIL , SEDIMENT, GROUNDWATER AND SURFACE WATER

COPCs	Excavated/ Drainage Areas Shallow Soils	Impoundment Area Subsurface Soil	Impoundment/ Drainage/ Tributary Areas Sediment	Groundwater (Total and Dissolved)	Impoundment/ Drainage/ Tributary Areas (Total and Dissolved)
Volatiles:					
1,1-Dichloroethane			X	X	X
1,2-Dichloroethane			X		
1,1-Dichloroethene		X	X	X	X
cis-1,2-Dichloroethene		X		X	
trans-1,2-Dichloroethene		X		X	
1,2-Dichloroethene (Total)			X		X
1,1,2,2-Tetrachloroethane		X			X
Tetrachloroethene		X	X		
1,1,1-Trichloroethane			X	X	X
1,1,2-Trichloroethane		X			
Trichloroethene		X	X	X	
Vinyl Chloride		X	X		
Semivolatiles:					
Acenaphthene			X		
Anthracene			X		
Benzo(a)anthracene	X		X		X
Benzo(a)pyrene	X		X		X
Benzo(b)fluoranthene	X		X		X
Benzo(k)fluoranthene	X		X		X
Benzo(g,h,i)perylene			X		
Carbazole			X		
Chrysene	X		X		X
Dibenzo(a,h) anthracene	X		X		
2,4-Dinitrotoluene			X		
2,6-Dinitrotoluene			X		
Fluoranthene			X		
Fluorene			X		
Indeno(1,2,3-cd) pyrene	X		X		
2-Methylnaphthalene			X		
Naphthalene			X		
Phenanthrene			X		X
Pyrene			X		
Nitramines:					
2-Amino-4,6-Dinitrotoluene		X			
4-Amino-2,6-Dinitrotoluene		X	X	X	
1,3-Dinitrobenzene			X		
HMX			X		X
RDX		X	X	X	X
1,3,5-Trinitrobenzene		X	X		
2,4,6-Trinitrotoluene		X	X		X
Inorganics:					
Aluminum	X		X		X
Antimony	X	X	X	X	X
Arsenic	X	X	X	X	X
Beryllium	X	X	X		X
Cadmium	X		X		
Chromium	X	X	X		X
Iron	X	X	X	X	X
Lead					X
Manganese	X	X	X	X	X
Mercury					X
Nickel			X		X
Thallium				X	
Vanadium			X		X
Zinc	X		X	X	

TABLE 2

SITE 7 AND FELGATES CREEK
SUMMARY OF COPCs FOR SOIL, SEDIMENT, GROUNDWATER, AND SURFACE WATER

COPCs	Site 7 Shallow Soils	Site 7 Subsurface Soil	Site 7 Ground-water (Total and Dissolved)	Site 7 Surface Water (Total and Dissolved)	Site 7 Sediment
Volatiles: 1,1-Dichloroethane			X		
1,1-Dichloroethene			X		
1,1,1-Trichloroethane			X		
Nitramines: 4-Amino-2,6-DNT			X		
RDX			X		
Inorganics: Aluminum	X	X	X		X
Antimony	X	X	X		
Arsenic	X	X	X	X	X
Beryllium	X	X			X
Cadmium	X				
Chromium	X	X	X		X
Iron	X	X	X	X	X
Manganese	X	X	X	X	X
Vanadium			X		X

TABLE 3

HUMAN HEALTH RISK ASSESSMENT SCENARIOS

Population	Pathway
Current on-station adult and adolescent (7-15 years old) trespassers	- accidental ingestion of surface soil - dermal contact with surface soil - inhalation of fugitive dust - accidental ingestion of surface water - accidental ingestion of sediment - dermal contact with sediment
Current civilian adult worker	- accidental ingestion of surface soil - dermal contact with surface soil - inhalation of fugitive dust - accidental ingestion of surface water - dermal contact with surface water - accidental ingestion of sediment - dermal contact with sediment
Future on-site adult and young child (1-6 years old) residents	- accidental ingestion of surface soil - dermal contact with surface soil - accidental ingestion of groundwater (nonpotable use) - dermal contact with groundwater (nonpotable use) - accidental ingestion of surface water - dermal contact with surface water - accidental ingestion of sediment - dermal contact with sediment
Future adult and adolescent (7-15 years old) recreational user at Felgates Creek and tributaries	- accidental ingestion of surface water - dermal contact with surface water - accidental ingestion of sediment - dermal contact with sediment
Future on-site adult construction workers	- accidental ingestion of subsurface soil - dermal contact with subsurface soil - inhalation of fugitive dust
Future on-site adult commercial workers	- accidental ingestion of surface soil - dermal contact with surface soil - inhalation of fugitive dust

REMEDIATION GOALS, AREAS OF CONCERN, AND REMEDIAL ACTION OBJECTIVES

Remediation Goals

Remediation goals are site-specific clean-up goals established for the various COPCs in environmental media that require remediation at a site. Further evaluation of the COPCs in the Feasibility Study (FS) was done to determine that concentrations of cadmium and zinc in surface soil may pose a potential ecological risk. For sediment, volatile compounds [1,1-DCA, 1,2-DCE, tetrachloroethene (PCE), 1,1,1-TCA and TCE], semivolatiles [PAHs], explosives [total DNTs, total amino-DNTs, HMX, RDX, 1,3,5-trinitrobenzene (1,3,5-TNB), and TNT] and inorganics [cadmium, lead, mercury, nickel and zinc] may also pose a potential human health and ecological risk.

The Final Remediation Levels (RLs) that were developed for each contaminant in each media are presented in Table 4.

Areas of Concern

Based on the RLs for the Contaminants of Concern (COCs) as presented on Table 4, three Site Areas of Concern (SAOCs) were identified at Site 6 (Figures 3, 4 and 5) where the COC concentrations exceed the RLs.

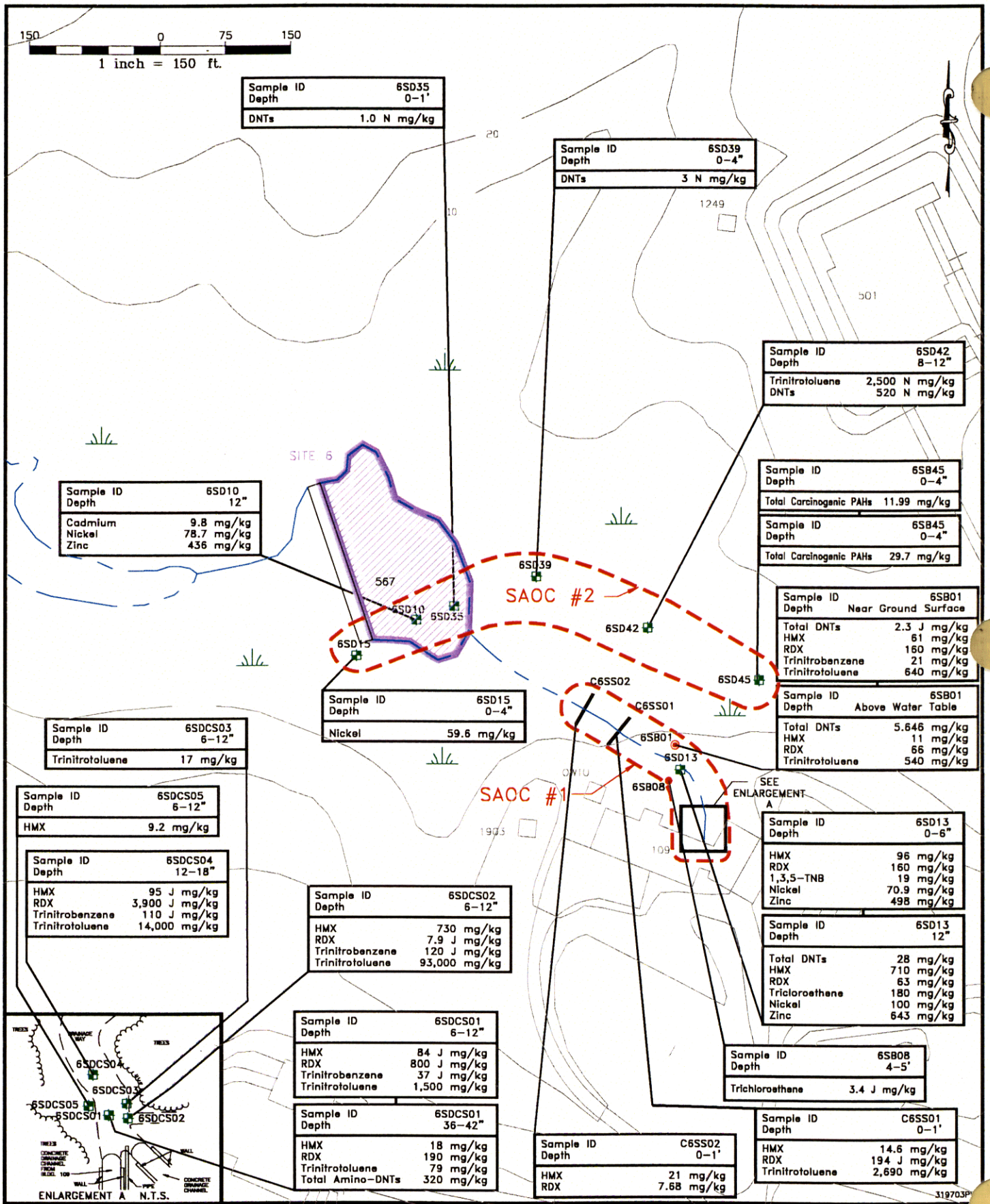
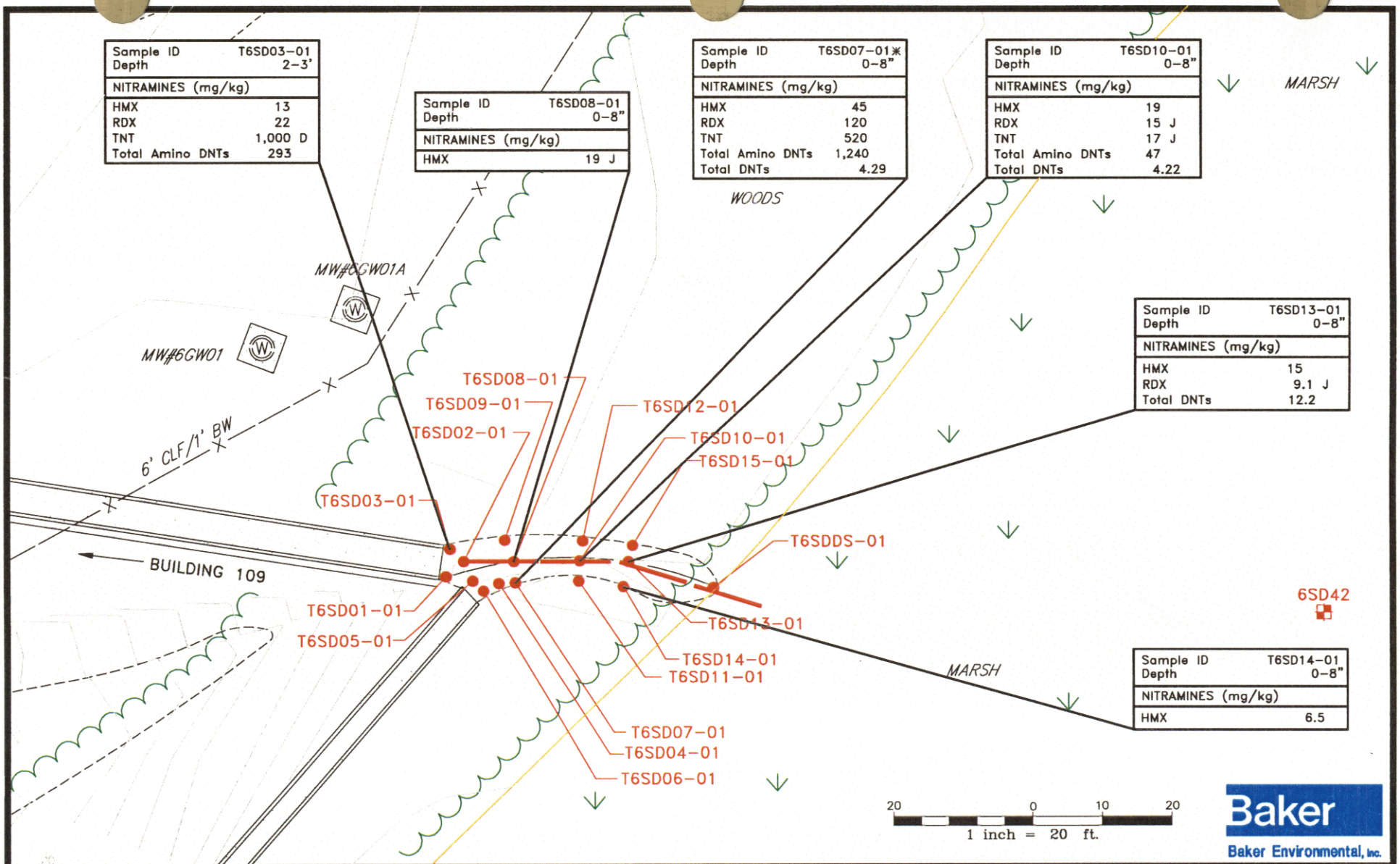


FIGURE 3
COC CONCENTRATIONS EXCEEDING REMEDIATION LEVELS
SITE 6 - SAOC # 1 AND 2

NAVAL WEAPONS STATION YORKTOWN — YORKTOWN, VIRGINIA

01838EB02Y


Sample ID T6SD03-01
Depth 2-3'
NITRAMINES (mg/kg)
HMX 13
RDX 22
TNT 1,000 D
Total Amino DNTs 293
Sample ID T6SD08-01
Depth 0-8"
NITRAMINES (mg/kg)
HMX 19 J
Sample ID T6SD07-01*
Depth 0-8"
NITRAMINES (mg/kg)
HMX 45
RDX 120
TNT 520
Total Amino DNTs 1,240
Total DNTs 4.29
Sample ID T6SD10-01
Depth 0-8"
NITRAMINES (mg/kg)
HMX 19
RDX 15 J
TNT 17 J
Total Amino DNTs 47
Total DNTs 4.22
Sample ID T6SD13-01
Depth 0-8"
NITRAMINES (mg/kg)
HMX 15
RDX 9.1 J
Total DNTs 12.2
Sample ID T6SD14-01
Depth 0-8"
NITRAMINES (mg/kg)
HMX 6.5
MARSH
WOODS
MARSH
MW#6GW01A
MW#6GW01
6' CLF/1' BW
BUILDING 109
CONC FLUME
T6SD08-01
T6SD09-01
T6SD02-01
T6SD03-01
T6SD12-01
T6SD10-01
T6SD15-01
T6SDDS-01
T6SD01-01
T6SD05-01
T6SD13-01
T6SD14-01
T6SD11-01
T6SD07-01
T6SD04-01
T6SD06-01
6SD42
20 0 10 20
1 inch = 20 ft.
Baker
Baker Environmental, Inc.
LEGEND
– APPROXIMATE IMPOUNDMENT AREA BOUNDARY
– SEDIMENT SAMPLE LOCATIONS
– SUPPLEMENTAL INVESTIGATION SEDIMENT SAMPLE LOCATION
* – SAMPLE USED IN TOXICITY STUDY
** – SAMPLE USED IN DILUTION FOR TOXICITY STUDY
SEDIMENT COLLECTED FROM 0 TO 8 INCHES, EXCEPT T6SD03-01, WHICH WAS COLLECTED AT 2 TO 3 FEET.
SOURCE: MILLER-STEPHENSON AND ASSOCIATES, JAN. 1996.
FIGURE 4
TOXICITY TEST SEDIMENT SAMPLING DATA
NITRAMINE COMPOUND DETECTIONS
EXCEEDING REMEDIATION LEVELS
SITE 6 - SAOC #1
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA
319705PR

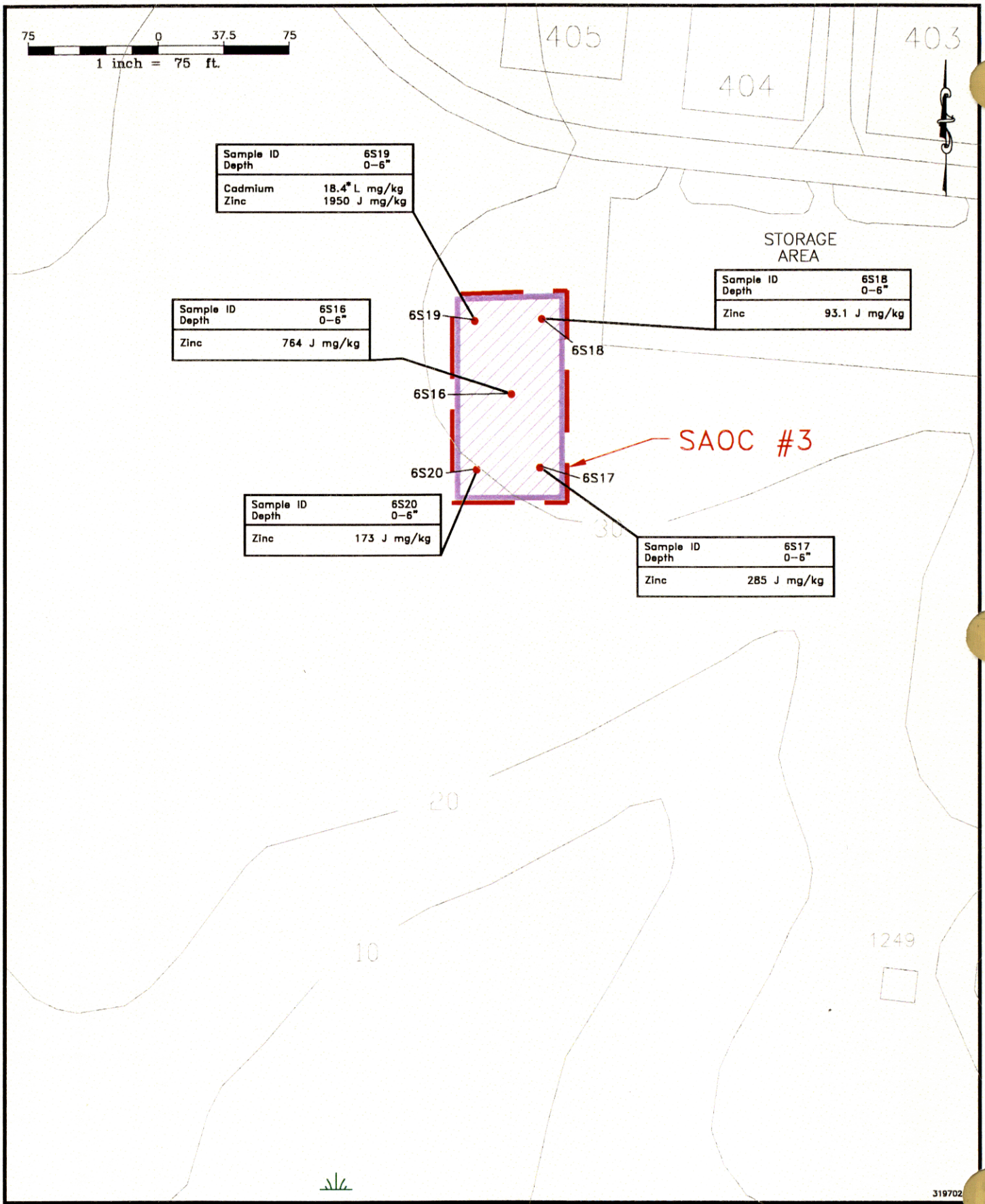


FIGURE 5
COC CONCENTRATIONS EXCEEDING REMEDIATION LEVELS
SITE 6 - SAOC #3

NAVAL WEAPONS STATION YORKTOWN YORKTOWN, VIRGINIA

SAOC #1 includes the drainage flume area. The COCs that exceed RLs are TCE, HMX, RDX, 1,3,5-TNB, total DNTs, total amino-DNTs, TNT, nickel and zinc. The 200-foot long flume area is approximately 10 feet wide encompassing an area of about 2,000 square feet, and is assumed to be contaminated to a depth of approximately 5 feet. The estimated volume of contaminated soil/sediment in SAOC #1 is approximately 370 cubic yards (cy). Further, this volume of sediment has been identified as a RCRA listed waste (F002) because it contains approximately 40 cy of a tar-like substance containing chlorinated solvents.

TABLE 4

FINAL REMEDIATION LEVELS FOR SITE 6

Medium/Chemical of Concern	Final Remediation Level (mg/kg)	Source
SEDIMENT		
Trichloroethene	1.6	Ecological[1]
1,2-Dichloroethene(+)	3.5	Ecological[1]
Tetrachloroethene	31	Human[3]
1,1-Dichloroethane	200,000	Human[3]
1,1,1-Trichloroethane	70,500	Human[3]
cPAHs*	10	Human[3]
total PAHs	44	Ecological[1]
amimo-DNTs	10	Human[3]
2,4/2,6-DNTs	0.6	Human[3]
HMX	5.7	Ecological[2]
RDX	5.0	Human[3]
1,3,5-TNB	1.6	Ecological[2]
2,4,6-TNT	14.0	Human[3]
Cadmium	9.6	Ecological[1]
Lead	400	Human[4]
Mercury	0.7	Ecological[1]
Nickel	52	Ecological[1]
Zinc	410	Ecological[1]
SOIL		
Cadmium	4.0	Ecological[5]
Zinc	48.4	Background[6]

Notes:

[1] ER-M value.
[2] Derived from site specific toxicity testing.
[3] Based on future commercial property use scenario.
[4] Based on IUBK model soil value for residential child.
[5] Will and Suter value for flora toxicity.
[6] Maximum detected Station-wide surface soil background value.

Considers a 10^{-5} scenario for all cPAHs as benzo(a)pyrene.

SAOC #2 is a portion of the impoundment area and adjacent areas. The COCs that exceed RLs total DNTs, TNT, total carcinogenic PAHs, cadmium, nickel, and zinc. This area encircles small hot spots of contaminated sediment. Assuming a ten foot by ten foot contaminated area at each of the six hot spots in SAOC #2, the actual contaminated area measures 600 square feet and is assumed to be contaminated to a depth of 1 foot. The estimated volume of contaminated sediment hot spots in SAOC #2 is approximately 25 cy. SAOC #3 is the Excavated Area at Site 6 (shallow soil). Two COCs, cadmium and zinc, exceed their RLs. This area measures approximately 7,200 square feet and is assumed to be contaminated to a depth of 6 inches. The estimated volume of contaminated soil in SAOC #3 is 133 cy.

Areas identified as RCRA AOC C and SWMU 179 are considered a potential secondary source of explosives contamination in the Site 6 Drainage Flume. These areas include the contents of the sewer drains under Building 109. A half-inch layer of sludge residue covers the drains. Assuming the entire area under Building 109 is contaminated (11,800 square feet), approximately 18 cy of sludge residue is in the sewer drains.

Remedial Action Objectives

Remedial action objectives are objectives for a remediation project that will address the contaminants and media of interest, the exposure pathways, and preliminary remediation. The remedial action objectives must be specific to the site, but not so specific that the range of possible alternatives to clean up the site would be limited.

The following remedial action objectives have been developed for Site 6:

- Mitigate direct exposure of potential human and ecological receptors to contaminated soil and sediment (as determined by a comparison to the RLs developed for the site) in the Site 6 impoundment area and drainage flume area. The COCs in the impoundment area include: VOCs [TCE; 1,2-DCE; PCE; 1,1-DCA, 1,1,1-TCA], SVOCs [total PAHs], nitramines [total DNTs; total amino-DNTs; HMX; RDX; 1,3,5-TNB; 2,4,6-TNT], and inorganics [cadmium; lead; mercury; nickel; zinc].

- Mitigate direct exposure of potential ecological receptors to contaminated surface soil in the Site 6 excavated area with cadmium concentrations greater than 4.0 mg/kg or zinc concentrations greater than 48.4 mg/kg.

- Reduce or eliminate potential secondary sources of VOC and/or nitramine contamination associated with SWMU 179 and AOC C.

SUMMARY OF ALTERNATIVES

A selected site remedy should be protective of human health and the environment; be cost effective; comply with other

statutory laws; and utilize permanent solutions, alternative treatment technologies, and resource recovery alternatives to the maximum extent practicable. In addition, the remedy should comply with a statute that prefers the use of treatment as a principal element for the reduction of toxicity, mobility, or volume of hazardous substances.

Remedial action alternatives (RAAs) were developed in the FS Report to address the remedial action objectives developed for Site 6. The FS evaluated six RAAs as described below. Note that all costs are estimated.

RAA 1: No Action

Capital Cost: $0
Operation and Maintenance (O&M) Cost: $0
Net Present Worth (NPW) Cost: $0

Time to Implement: This alternative can be immediately implemented.

Under the No Action Alternative, surface and subsurface soil, and sediment at Site 6 will remain as it is. No active remedial actions will be implemented, and no monitoring will be conducted. This RAA is developed to be used for a baseline comparison with other RAAs.

There are no chemical-, location-, or action-specific Applicable or Relevant and Appropriate Requirements (ARARs) for this alternative.

RAA 2: No Action with Monitoring and Sludge Removal

Capital Cost: $57,700
O&M Cost: $11,800
NPW Cost: $239,000

Time to Implement: This RAA can be implemented in a period of weeks, assuming work plans and long-term monitoring plans are completed. Sediment sampling can begin immediately and pressure washing of Building 109 can be completed in several weeks.

RAA 2 differs from the No Action Alternative by including long-term sediment monitoring at SAOC #1 and SAOC #2, and removal of sludge from sewer trenches under Building 109. No active containment or treatment response actions to reduce the toxicity, mobility, or volume of contaminants in the soil/sediment are included under this RAA.

Under RAA 2, this sludge residue will be physically removed and treated at an on-site permitted burning area. The sewer trenches will then be steam cleaned with pressurized water. Water from steam cleaning activities will be collected and disposed. The entrance to the concrete flume leading to Building 109 will be grouted in order to prevent potential building contaminants from entering the impoundment area.

Since contaminated soil/sediment would remain on site und RAA 2 and will continue to be a source of contamination, annual sediment monitoring will be conducted to assess the potential on-going impact to human health and the environment. Two sediment samples will be collected annually, at SAOC #1 and will be analyzed for VOCs and explosives. No fewer than six sediment samples will be collected annually at SAOC #2 and analyzed for VOCs, SVOCs, explosives, and inorganics. The details of the monitoring program will be addressed in the long-term monitoring work plan.

No chemical-specific ARARs have been established for the sediment/soil COCs. Implementation of RAA 2 may require compliance with location- and action-specific ARARs because wetlands, and possibly archeological resources, are present at the site.

RAA 3: In Situ Biological Treatment, Soil Cover, and Sludge Removal

Capital Cost: $393,600
O&M Cost: $11,300
NPW Cost: $567,300

Time to Implement: This RAA can be implemented withi approximately 6 to 9 months assuming that all work plans a long-term monitoring plans are completed. The installation o the soil cover should be completed within six months. Treatment of the soil may be completed within three to nine months. Sediment monitoring can begin immediately.

RAA 3 consists of in situ biological treatment of soil and sediment from SAOC #1, sediment monitoring at SAOC #2, installing a soil cover at SAOC #3, and removal of the sludge from Building 109.

Soil and sediment in SAOC #1 is contaminated with chlorinated compounds (including the tar-like RCRA listed waste F002), explosives, and inorganics. Three-hundred and seventy cubic yards of soil and sediment will be treated with an in situ bioremediation process. Naturally occurring nonhazardous materials will be applied to the soil and sediment. The soil will be alternated between aerobic and anaerobic conditions to reductively dechlorinate and aerobically mineralize the chlorinated compounds and explosives. Inorganic COCs in this SAOC, will not be treated by this process.

Ordinary equipment can be used to till the affected area every two weeks. The additives will bulk the soil and sediment approximately 10 percent. Indigenous microbe growth is enhanced; no foreign microbes are added to the soil. Because the area being treated is a drainage area, it is assumed that r water will need to be added to the soil and sediment for process to work.

To prevent extensive disturbance to the tidally influenced marshy area, no active treatment will occur at SAOC #2 under RAA 3. No fewer than six sediment samples will be collected annually and analyzed for VOCs, SVOCs, explosives, and inorganics. The details of the monitoring program will be addressed in the long-term monitoring work plan.

This RAA also includes installing a soil cover at SAOC #3. The surface soil in the Excavated Area of Site 6 (SAOC #3) is contaminated with zinc and cadmium concentrations that are above their RL values derived from ecological models. For RAA 3, the surface soil in this area will be covered with 6-inches of soil fill (135 cy) and 6-inches of topsoil (135 cy) and vegetated with native species. The area will also be enclosed with a permanent fence (approximately 500 linear feet) to prevent disturbance of the area.

Under RAA 3, the sludge will be removed from the sewer trenches under Building 109 and treated as described for RAA 2.

No chemical-specific ARARs have been established for the sediment/soil COCs. Land disturbing activities at SAOC #1 and SAOC #3 are involved with this RAA. Location-specific ARARs are associated with this RAA because wetlands, an osprey nesting site, and possibly archeological resources, are present at the site. Action-specific ARARs associated with the identification, regulation, production and disposal of solid wastes and hazardous wastes will apply.

RAA 4: Ex Situ Biological Treatment, Limited Excavation and Off-Site Disposal, and Sludge Removal

Capital Cost: $427,000
O&M Cost: $10,800
NPW Cost: $593,000

Time to Implement: This RAA can be implemented within approximately nine months assuming that all work plans and long-term monitoring plans are completed. The organic-contaminated soil can be excavated and placed in the biocell within approximately three months. Treatment of the soil may be completed within three to nine months. Excavation and off-site disposal of the inorganic-contaminated soil can be implemented within three to six months assuming an off-site landfill is available.

RAA 4 consists of ex situ biological treatment of the soil and sediment at SAOC #1, sediment monitoring at SAOC #2, excavation and off-site disposal of soil at SAOC #3, sewer sludge removal from Building 109 and plugging the sewer outlet from Building 109.

For this RAA, approximately 370 cy of soil and sediment will be excavated from SAOC #1 and trucked to the existing biocell at Site 22 at WPNSTA Yorktown. Routine sampling for explosives and VOCs will be performed to assess the effectiveness of the treatment process. Approximately 40 cy of this sediment is a tar-like RCRA listed waste (F002) which will be separated and transported off-site for disposal.

The VOCs and explosives detected in SAOC #1 will be bioremediated in the biocell. The nickel and zinc concentrations will not be reduced by the treatment.

To prevent extensive disturbance to the intertidal marshy area at SAOC #2, no active remediation will take place. Long-term sediment monitoring will be done as described for RAA 3.

For RAA 4, the inorganic-contaminated surface soil at SAOC #3 (270 cy) will be excavated and loaded onto trucks for off-site disposal. Confirmatory sampling will be conducted to ensure that the inorganic COCs are removed.

Under RAA 4, the sludge will be removed from under Building 109 and treated as described for RAA2.

No chemical-specific ARARs have been established for the sediment/soil COCs. However, because earth moving activities are involved with RAA 4, location-specific ARARs apply because wetlands, an osprey nesting site, and possibly archeological resources, are present at the site. Action-specific ARARs associated with the identification, regulation, production and disposal of solid wastes and hazardous wastes will apply. No chemical-specific ARARs have been established for the sediment/soil COCs. However, because a RCRA listed waste (F002) is being excavated, it must be treated to below regulatory limits before it can be disposed in a permitted landfill or placed back onto the ground at the Station (after obtaining a "contained out" determination from the regulatory authorities).

RAA 5: Excavation with Thermal Treatment and Sludge Removal

	RAA 5a Incineration	RAA 5b LTTD
Capital Cost:	$791,000	$402,000
O&M Cost:	$ 10,800	$ 10,800
NPW Cost:	$957,000	$568,000

Time to Implement: This RAA can be implemented within approximately three to six months assuming that an off-site incineration facility (RAA 5a), a mobile low temperature thermal desorption (LTTD) unit (RAA 5b), and off-site landfill facility are available, and all work plans are completed. Sediment monitoring can begin immediately assuming all monitoring plans are completed.

RAA 5 includes the excavation of the contaminated soil/sediment from SAOC #1 and contaminated surface soil at SAOC #3. Confirmation sampling will be conducted to verify that soil and sediment with COC concentrations exceeding the RLs has been removed. Contaminated soil and sediment will be loaded into trucks equipped to haul contaminated solids. Three-

hundred and seventy cubic yards of soil and sediment from SAOC #1 will be transported to the nearest incineration facility permitted to incinerate explosives-contaminated and RCRA listed F002 waste (RAA 5a), or treated on site in a mobile LTTD unit (RAA 5b).

Confirmation sampling will determine if the soil from SAOC #3 is hazardous or nonhazardous. Then the inorganic contaminated soil (270 cy) will be transported to the nearest approved disposal facility.

To prevent extensive disturbance to the intertidal marshy area at SAOC #2, no active remediation will take place. Long-term sediment monitoring will be conducted as described for RAA 3.

Under RAA 5, the sewer sludge will be removed from under Building 109 as described in RAA 2.

RAA 5 also includes the demolition and disposal of the oil/water treatment unit (OWTU) shown to the northwest of Building 109 on Figure 3.

No chemical-specific ARARs have been established for the sediment/soil COCs. Because earth moving activities are involved with RAA 5, location-specific ARARs apply because wetlands, an osprey nesting site, and possibly archeological resources, are present at the site. Action-specific ARARs associated with the identification, regulation, production, treatment and disposal of solid wastes and hazardous wastes will apply. Action-specific air quality ARARs will be met by RAA 5b which includes on-site thermal treatment of the contaminated sediment that may produce air emissions.

RAA 6: Ex Situ Biological Treatment, Soil Cover, Limited Excavation, and Sludge Removal

Capital Cost:	$462,000
O&M Cost:	$ 20,200
NPW Cost:	$772,500

Time to Implement: This RAA can be implemented within approximately 6 to 9 months assuming that all work plans and long-term monitoring plans are completed. The installation of the soil cover may be completed within six months. Treatment of the soil may be completed within three to nine months. Sediment monitoring can begin immediately.

RAA 6 includes excavating the contaminated soil/sediment at the Drainage Flume Area, SAOC #1, and treating it on-site with an ex situ bioremediation process. The same process as described for RAA 3 will be used for this treatment with the exception that it will be excavated and placed at a staging area to the west of Building 109 instead of being treated in place. Assuming a 200 foot long by 10 foot wide area drainageway, and a five foot depth of excavation, 370 cy of soil and sediment, including approximately 40 cy of a tar-like RCRA listed waste, from SAOC #1 will be excavated. The RCRA listed waste will be separated from the soil and sediment, and transported to an off-site disposal facility. The area will be restored with 370 cy of backfill and a 6-inch layer of topsoil (40 cy) for revegetati

To prevent extensive disturbance to the sediment at the Site 6 Impoundment Area, SAOC #2, no active remediation will be performed. However, long-term surface water and groundwater monitoring for all of Site 6, and long-term sediment monitored at and around the Impoundment Area, will be conducted to assess the potential ongoing impact to human health and the environment. All three media will be sampled and analyzed for VOCs, SVOCs, explosives, and inorganics. The details of the monitoring program will be addressed in the long-term monitoring work plan.

A soil cover will be installed at the Site 6 Excavated Area, SAOC #3, as described in RAA 3 with the exception that fence will not be installed for this RAA.

Sludge residue will be removed from the sewer trenches under Building 109, and treated and the trenches pressure washed as described in RAA 2.

No chemical-specific ARARs have been established for the sediment/soil COCs. Because earth-moving activities are involved with RAA 6, location-specific ARARs apply because wetlands, an osprey nesting site, and possibly archeological resources, are present at the site. Acti specific ARARs associated with the identificati regulation, production and disposal of solid wastes and hazardous wastes will apply. However, because a RCRA listed waste (F002) is being excavated, it must be treated to below regulatory limits before it can be disposed in a permitted landfill or placed back onto the ground at the Station (after obtaining a "contained out" determination from the regulatory authorities).

EVALUATION OF ALTERNATIVES

The Navy's preferred alternative for Site 6 is RAA 6: Ex Situ Biological Treatment, Soil Cover, Limited Excavation, and Sludge Removal. It includes sludge removal from under Building 109, excavation of soil and sediment from SAOC #1 for ex situ biological treatment, confirmation sampling and possible excavation for off-site disposal of soil from SAOC #2, and installation of a soil cover at SAOC #3, and long term sediment, surface water and groundwater monitoring. The main components of the preferred alternative are shown in Figure 6. As stated previously, No Action is recommended for Site 7.

As part of the FS process, each of the RAAs were assessed against nine evaluation criteria which fall into three categories: threshold criteria, primary balancing criteria, and modif criteria. The threshold criteria must be met for an alternati be eligible for selection. The primary balancing criteria are used to weigh major trade-offs among alternatives. Generally, the

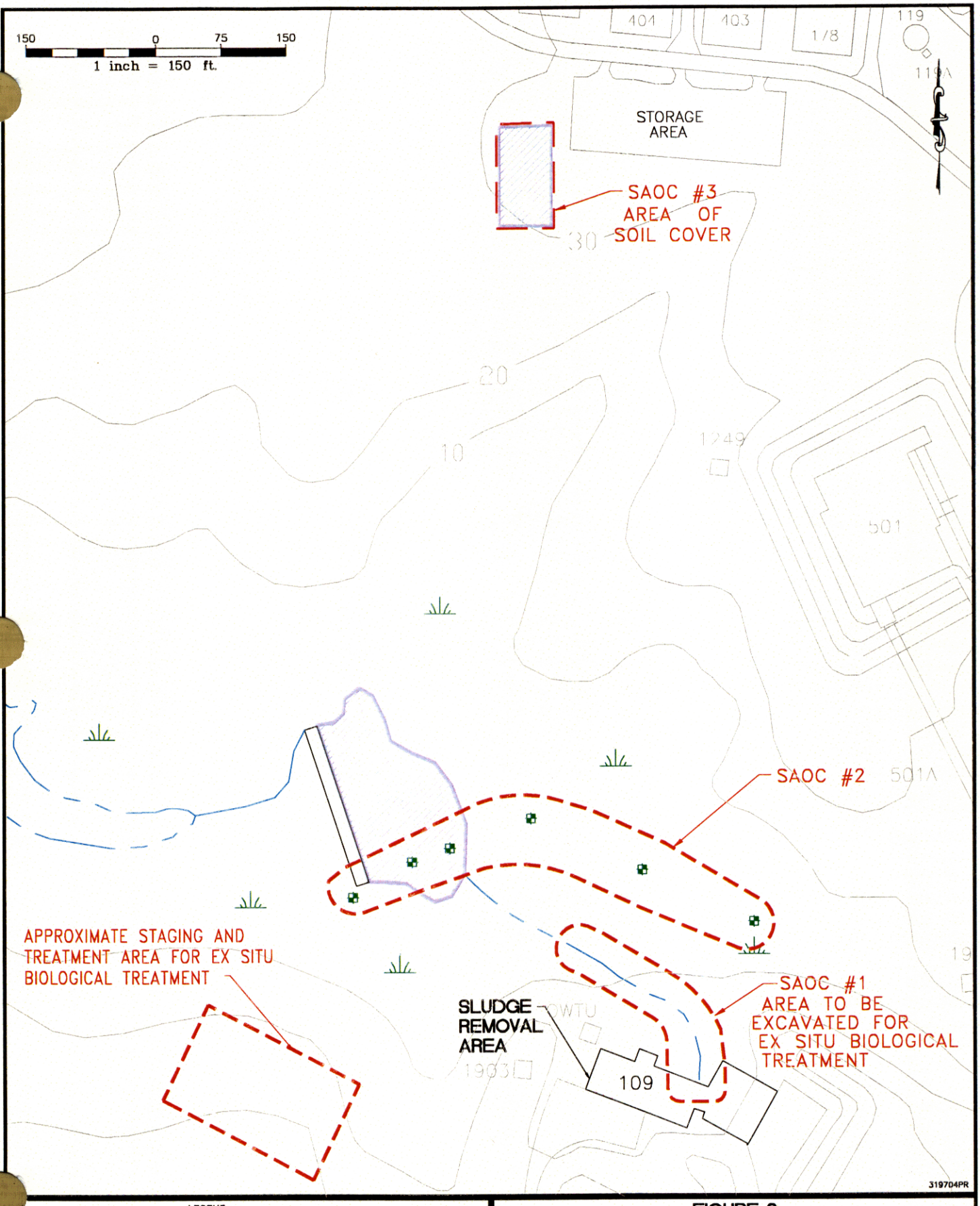


FIGURE 6
PREFERRED ALTERNATIVE: EX SITU BIOLOGICAL TREATMENT, SOIL COVER, LIMITED EXCAVATION, AND SLUDGE REMOVAL AT SITE 6
NAVAL WEAPONS STATION YORKTOWN YORKTOWN, VIRGINIA

modifying criteria are taken into account after public comment is received on the PRAP. The nine evaluation criteria include:

Threshold Criteria:
- Overall Protection of Human Health and the Environment
- Compliance with ARARs

Primary Balancing Criteria:
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume Through Treatment
- Short-Term Effectiveness
- Implementability
- Cost

Modifying Criteria
- State Acceptance
- Community Acceptance

Table 5 presents a brief description of each of the criterion. A comparative analysis of the RAAs that were presented in the FS, and the preferred alternative presented in this PRAP, based upon the evaluation criteria follows.

Overall Protection of Human Health and the Environment

RAAs 3, 4, 5, and 6 provide the greatest extent of protection to human health and the environment since these RAAs provide source control by removing and treating the primary source of contamination at Site 6 (SAOC #1) and removes a potential secondary source of contamination (the sludge within Building 109 sewer system). RAA 2 will provide some overall protection with the implementation of a long-term monitoring program and with the removal of the potential secondary source of contamination (sludge from Building 109). RAA 1, the No Action Alternative, does not reduce potential risks to human health or the environment (except through possible natural biodegradation processes).

Compliance with ARARs

Where applicable, all of the RAAs should be able to comply with the location-specific and action-specific ARARs. There are no chemical-specific ARARs established for the soil/sediment COCs, unless the RCRA listed waste (F002) is excavated. RAAs 4, 5, and 6 require excavation of the waste. RAAs 5 and 6 will be able to meet the chemical-specific treatment requirements. It is unknown if RAA 3 will be able to meet these requirements for this waste.

Long-Term Effectiveness and Permanence

RAAs 4, 5, and 6 will be the most effective and permanent alternatives since the soil/sediment COCs from SAOC #1 and the sludge from Building 109 will be removed from the site. RAAs 4 and 5 will also be permanent with regard to SAOC #3 through removal and disposal of the inorganic-contaminated soil. RAA 6 includes a soil cover at SAOC #3. The permanence of this depends on adequate maintenance of the cover. RAA 3 will also be an effective alternative since the soil/sediment from SAOC #1 will be treated and the sludge from Building 109 will be removed. In addition, as long as the soil cover and fence SAOC #3 are adequately maintained, the effectiveness permanence of RAA 3 will be increased. The in-situ biological treatment at SAOC #1 may not be able to adequately treat the RCRA listed waste in the sediment, possibly leaving unacceptable risk at the site. RAA 2 provides minimal long-term permanence with the exception that the sludge from Building 109 (potential secondary source of contamination) will be removed. The long-term effectiveness and permanence of the No Action Alternative is unknown. It is possible that, through natural attenuation, the organic soil/sediment COC concentrations will decrease. The No Action Alternative does not include any methods to monitor this passive remediation.

All of the RAAs will require five year reviews since COCs above the RLs will remain on site (SAOC #2).

Reduction of Toxicity, Mobility, or Volume Through Treatment

RAAs 3, 4, 5, and 6 include treatment as a primary component of the alternative. Under each of these RAAs, the primary source of contamination (SAOC #1) will be treated either on site or off site. However, RAA 3 may not adequately treat the RCRA listed waste at SAOC #1 in situ. RAAs 1 and 2 do not include any form of active treatment.

Short-Term Effectiveness

The No Action RAA will have no short-term effects on human health and the environment because this alternative does not involve remedial actions. RAA 2 will have the minimal short-term effects since only temporary increased risks to workers will occur during the sludge removal, steam cleaning and sediment sample collection activities. RAAs 3, 4, 5a, and 6 will have similar short-term effects on human health and the environment due to the activities such as excavation, sludge removal, steam cleaning, sample collection, and other earth-moving activities. RAA 5b may increase short term risk due to air emissions.

The treatment RAAs (RAAs 3, 4, 5, and 6) are anticipated to achieve the remedial action objectives for source control within one year. All of the RAAs, with the exception of RAA 1, include long-term monitoring for an estimated 30 years. RAA 1 will not achieve the remedial action objectives.

Implementability

Since RAA 1 will not involve remedial actions, there are no implementability concerns. RAA 2 will be the next easiest alternative to implement since only sludge removal and treatment and sediment sampling equipment and resources are needed. The other three treatment RAAs should have similar implementability needs. RAAs 3, 4, 5, and 6 will require coordin with off-site treatment and/or disposal facilities. RAA 5b also require more extensive permitting and a scrubber due to air emissions from chlorinated solvent contaminants.

Cost

terms of NPW, the no action alternative (RAA 1) would be e least expensive alternative to implement. The estimated NPW values of the RAAs and the preferred alternative in increasing order by cost are:

- $0 (RAA 1)
- $239,000 (RAA 2)
- $567,300 (RAA 3)
- $568,000 (RAA 5b)
- $593,000 (RAA 4)
- $772,500 (RAA 6)
- $957,000 (RAA 5a)

The preferred alternative, RAA 6, is the second most expensive alternative. However, it includes more extensive long-term monitoring. Only the incineration alternative is more expensive than the preferred alternative.

Table 6 ranks the alternatives against each other according to how well they address the threshold and primary balancing criteria. Each alternative can be ranked 1 to 6, with 1 being the best and 6 being the worst. If two or more alternatives are equal to each other in addressing a criteria, they are given the same rank. The rankings are summed up, and the alternative with the lowest total is considered to be the best overall alternative. The bjective ranking is based on the previous evaluation of rnatives discussion.

State Acceptance

This criterion was not evaluated in the FS. It will be considered once comments from the State are received on the FS and PRAP documents.

Community Acceptance

This criterion was not evaluated in the FS. It will be considered following the receipt of comments generated during the public comment period.

SUMMARY OF THE PREFERRED ALTERNATIVE

Based on an evaluation of the various RAAs developed for Site 6, the DoN's preferred alternative is RAA 6.

No action is recommended for Site 7 because the contamination was remediated during the Pilot Study.

The first activity at Site 6 under the preferred alternative would to remove and treat (at an on-site permitted burning area) proximately 18 cubic yards of sludge from the sewer trenches under Building 109.

TABLE 5

SUMMARY OF THE DETAILED EVALUATION CRITERIA

Threshold Criteria

Overall Protection of Human Health and the Environment:
This criterion is used to evaluate whether the RAA would achieve adequate protection of human health and the environment and how risks posed by each pathway would be eliminated, reduced, or controlled through treatment engineering, or institutional controls.

Compliance with ARARs:
This criterion is used to evaluate whether the RAA would meet all of the pertinent Federal and state chemical-, location-, and action-specific ARARs.

ARARs are any standards or regulations that are required by Federal or state law for the contaminants, location or activity at a particular project site. Some chemicals are specifically regulated for certain media (e.g., soil, surface water or groundwater). Certain areas are regulated as well, including wetlands or historic sites. Certain activities are regulated in order to prevent degradation of the environment (e.g., transport of hazardous waste).

Primary Balancing Criteria

Long-Term Effectiveness and Permanence
This criterion is used to determine the degree of permanence and residual risk that would remain at the site after remediation, and the effectiveness of the controls that will be applied to manage residual risks.

Reduction of Toxicity, Mobility, or Volume Through Treatment
This criterion is used to evaluate the degree to which the RAA uses treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of hazardous substances.

Short-Term Effectiveness:
This criterion is used to evaluate the effect on human health and the environment of the RAA during implementation of the remedial action (e.g., due to handling, treatment, or transportation of hazardous substances).

Implementability:
This criterion is used to evaluate how feasible the RAA is considering technical and administrative requirements, and availability of required services and materials.

Cost:
This criterion estimates the capital costs, O&M costs, and NPW values for each RAA evaluated.

Modifying Criteria

State Acceptance:
This criterion is used to solicit and address comments from State agencies during the preparation of the FS, PRAP and ROD reports. State acceptance will be determined during the public comment period of this PRAP.

Community Acceptance:
This criterion is used to solicit and address comments and concerns that the public has about the RAA. Community involvement will have a significant impact on the implementation of the selected alternative. Community acceptance will be determined during the public comment period of this PRAP.

TABLE 6

PRELIMINARY RAA RANKING

Criteria	Remedial Action Alternative						
	RAA 1	RAA 2	RAA 3	RAA 4	RAA 5a	RAA 5b	RAA 6
Threshold Criteria							
Overall Protection of Human Health and Environment	5	4	3	2	2	2	1
Compliance with ARARs	1	1	1	1	1	1	1
Primary Balancing Criteria							
Long-Term Effectiveness	4	3	2	3	1	1	1
Reduction of Toxicity, Mobility, Volume	3	3	2	2	1	1	1
Short-Term Effectiveness	5	1	3	2	2	3	3
Implementability	1	2	3	5	5	6	3
Cost	1	2	3	5	7	4	6
TOTALS	**20**	**16**	**17**	**20**	**19**	**17**	**16**

Notes: Alternative are ranked from a possible 1 to 6 with 1 being the best, and 6 being the worst, with regard to each criteria. Ties may occur if alternatives are equal to each other with regard to the criteria. Numbers based upon subjective review of comparative criteria as presented in the FS.

The trenches will be steam cleaned and the resulting wastewater collected and treated. The drain pipe from Building 109 leading to the Drainage Flume Area will be grouted shut. Contaminated soil and sediment from the Drainage Flume Area (SAOC #1) will be excavated and spread out in the staging and treatment area shown on Figure 6. Instead of the ex situ biological treatment at the biocell as described in RAA 4, a biological treatment process, as described for RAA 3 (In Situ Biological Treatment) will be used to treat the soil. The treatment will be done ex situ instead of in situ because the contamination is too deep at the Drainage Flume Area to be effectively treated with tilling equipment as described in RAA 3. SAOC #2 is part of the long term annual monitoring program proposed for OU 15. Groundwater, surface water and sediment will be sampled annually and analyzed for VOCs, SVOCs and explosives. Details of the monitoring plan will be addressed in the long term monitoring work plan. At SAOC #3, a soil cover will be installed as described in RAA 3. A cost estimate was developed for the preferred alternative based on the existing cost estimates for the RAAs evaluated in the FS. The capital cost for the preferred alternative was estimated to be approximately $462,000. The O&M costs for the preferred alternative including groundwater, surface water and sediment monitoring was estimated to be $20,200. Therefore, the NPW for the preferred alternative is $772,500. The major components of the preferred alternative are shown in Figure 6.

Based on the information currently available, the DoN believes the preferred alternative provides the best balance of trade-offs among the other alternatives with respect to the evaluation criteria. The preferred alternative satisfies the Comprehensive Environmental Response, compensation and Liability Act (CERCLA) Section 121(b) in that the DoN believes that the preferred alternative will be protective of human health and the environment, will comply with ARARs, will be cost-effecti[ve] and will utilize permanent solutions and alternative treatm[ent] technologies to the maximum extent practicable. The remed[y] meets the statutory preference for treatment as a principle element for SAOC #1. The remedy does not meet the statutory preference for treatment as a principle element for SAOCs #2 and #3.

COMMUNITY'S ROLE IN THE SELECTION PROCESS

The DoN relies on public input to ensure that the concerns of the community are considered in selecting an effective remedy for a site. The RI and FS Reports, PRAP, and supporting documentation have been made available to the public for a public comment period. A public meeting will be held during the public comment period to present the conclusions of the RI and FS; to elaborate further on the reasons for recommending the preferred alternative; and to receive public comments.

Comments should be directed to Mr. Scott Park at telephone number or address provided below. Comments received at the public meeting, as well as written comments received during the comment period, will be documented in the Responsiveness Summary section of the Record of Decision (ROD). The ROD formalizes the selection of the remedy.

Commander
Atlantic Division
Naval Facilities Engineering Command
1510 Gilbert Street (Bldg. N-26)
Norfolk, Virginia 23511-2699
Attention: Mr. Scott Park, Code 18223
Phone: (757) 322-4788/Fax: (757)322-4805

Both the PRAP and the Record of Decision (ROD) will be available at the information repositories listed below:

- York County Public Library
  8500 George Washington Highway
  Yorktown, VA 23692
  (757) 890-3377

- Gloucester Public Library
  P.O. Box 367, Main Street
  Gloucester, VA 23601
  (757) 693-2998

- Newport News City Library
  Grissom Branch
  366 Deshazor Drive
  Newport News, VA 23502
  (757) 886-7896

- Naval Weapons Station, Yorktown
  Environmental Directorate
  Building 31-B, P.O. Drawer 160
  Yorktown, VA 23691-0160
  (757) 887-4775 (Ext. 29)
  (Contact Mr. Jeff Harlow)

NOTES

GLOSSARY OF TERMS

This glossary defines several of the technical terms used in this PRAP. The terms and abbreviations contained in this glossary are often defined in the context of hazardous waste management, and therefore, they may have other meanings when used in a different context.

CARCINOGENS: Cancer causing substances.

COPC: A contaminant of potential concern is a compound that has been identified as posing a potential risk to human health or the environment.

EXPOSURE PATHWAY: The way in which receptors are exposed to site contaminants.

INCINERATION: A treatment technology which burns organic contaminants and is hot enough to destroy soil structure.

INORGANICS: A metal element which is absent of carbon (e.g., zinc) and is naturally occurring in the environment.

LTTD: Low temperature thermal desorption is a treatment technology that separates organic contaminants from soil by volatizing them (but not burning them). The separated contaminates are then burned and the soil retains its physical properties and can support biological activity.

NITRAMINES: A family of explosive organic compounds containing nitrogen and methylene attached to rings of carbon.

OU: An Operable Unit is a grouping of sites based on similar potential remedial solutions, geographic location, contaminants, or other factors.

RECEPTOR: An organism for example a person, plant, or animal, coming in contact with site contaminants.

SAOC: A Soil Area of Concern is an area of contaminated soil that has been delineated based on contaminant concentrations which are higher than concentrations that pose a potential risk to human health and the environment.

SEMIVOLATILE ORGANIC: Compounds of carbon chains or rings that are not light enough to evaporate easily. These chemicals are commonly found in plastics, tar and asphalt, paints, and fuels.

VOLATILE ORGANIC: Carbon compounds that are light enough to evaporate easily. These potentially toxic chemicals are used as solvents, degreasers, paints, thinners, and fuels.

MAILING LIST

If you are not on the mailing list and would like to receive future publications pertaining to Sites 6 and 7 at WPNSTA Yorktown, please fill out, detach, and mail this form to:

Commander
Atlantic Division
Naval Facilities Engineering Command
1510 Gilbert Street (Bldg. N-26)
Norfolk, Virginia 23511-2699
Attention: Mr. Scott Park, Code 18223

Name _____

Address _____

Affiliation _____

Phone ( ) _____

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Naval Facilities Engineering Command
1510 Gilbert Street (Bldg. N-26)
Norfolk, Virginia 23511-2699
Attention: Mr. Scott Park, Code 18223

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